

# Using Geospatial Information in *IMAGINE Essentials*<sup>®</sup>



Tools for GIS Professionals

*A city planner wants to find the best evacuation route for residents. A forestry company wants to accurately project its annual production. A utility company wants an accurate map depicting the location of its power lines. An environmental engineer wants to accurately calculate the loss of sensitive wetlands each year.*

*All of these professionals historically have used Geographic Information Systems (GIS) to collect and analyze data. Each requires different types of data, from different sources, for very different purposes. Retrieving that data, however—and getting into a usable format—is a challenge they all share.*

*With more data sources than ever before at their fingertips, today's GIS professionals can learn to seek out, recognize, collect and analyze data efficiently and effectively to produce superior output. This white paper discusses the issues GIS professionals face in these areas and the tools available to assist them.*



## POWERING GEOSPATIAL IMAGING™

### **The Geospatial Imaging Chain**

The Geospatial Imaging Chain consists of geographic imaging solutions, specifically designed for capturing, referencing, measuring, analyzing and presenting data in a format that is useful to geospatial information professionals.

**Capture.** Using sophisticated cameras, digital sensors, airborne LIDAR sensors, satellite imagery and post-processing software systems, raw geography and topography data can be obtained, recorded and archived as a permanent record of the earth's surface. Capturing the data is the first critical link in the Geospatial Imaging Chain.

**Reference.** Once captured, the raw data must be related to a ground reference system. This process ensures the data accurately corresponds to known locations on the earth's surface. Subsequent measurement, analysis or utilization in a geographic information system is completely dependent on the Reference link in the Geospatial Imaging Chain.

**Measure.** The stage is now set to pull out specific geographic information from the data source. Measure link in the Geospatial Imaging Chain lets you assess the data source and find specific data that is useful. You can then collect 2D and 3D vectors, points and areas, create digital terrain models or classify LIDAR points to discern ground characteristics. Extracted information can then be analyzed.

**Analyze.** Searching for relationships between images, ground features and even hidden objects is the basis of the Analyze link in the Geospatial Imaging Chain. Understanding these relationships lets you construct explanations and draw conclusions about the processes and activities taking place on the earth's surface.

**Present.** Decision makers need to be presented with valid and accurate information to do their jobs well. Whether as a hardcopy map, a 3D fly-through or a complex geographic database, reliable information extracted from the geospatial imaging chain can be visualized, shared, stored and, most importantly, presented digitally.

### **Getting the Most Out of Your GIS Data**

In some cases, a single map or satellite image is not sufficient. The image might be old or might not represent the ground to a sufficient level of detail. To be useful, the image must be augmented with additional information about the area being studied.

In other cases, data must be accumulated over time. An environmental engineer measuring wetland loss might require the use of several maps and images over time to make accurate calculations.

Geographic information is usually presented as aerial photographs, satellite images or vector data. Images portray a true representation of the ground, while vector data uses a set of mathematical data points to approximate the terrain. Together, images and vector data are used to study and map land surfaces.

The common problem among all users of GIS information is that, while they have access to more imagery than ever before, they lack the ability to gather and consolidate the data and to extract the information they need from it.

#### **Raster Images**

Imagery can be taken from satellites or from planes flying over an area of interest. These images might be black and white, true-color, color-infrared or even formed from Synthetic Aperture Radar (SAR). Regardless of type, the images are comprised of a matrix, or raster, of picture elements. These picture elements, called pixels, are the smallest piece of information contained in the image.

The area of ground represented by a single pixel determines the image's spatial resolution. For example, an image whose pixels represent an area five meters by five meters has a higher spatial resolution than an image whose pixels represent an area thirty meters by thirty meters. Images with high spatial resolution contain more detail than images with low spatial resolution but require a larger file size and consequently, more disk space on a computer.

A raster image can be made up of one or more layers recording the intensity of light at a particular wavelength. For example a true-color image would be made up of three layers, one recording the Red wavelength, one for Green and one for Blue. The number and type of layers determines the spectral resolution of a raster image.

Because different surfaces reflect light differently, color photographs are often used to identify various ground objects. For instance, healthy crops might reflect a different green light than blighted crops. Inspecting the different green patches in a satellite image of a field helps the farmer compare the amount of healthy crops to the amount of diseased crops. Man-made surfaces, forests and water reflect different colors of the spectrum, making spectral information or data an important component of geographical information analysis.

#### **Vector Data**

In contrast to raster data, geographic information can be represented as a collection of vectors—points, lines or polygons. This data can be associated with a number of useful attributes such as surface elevation, census data, indigenous vegetation and date of capture, and then stored in a database for later use. Vector information can also be useful for mapping certain objects that cannot be seen from overhead, such as underground gas or power lines.

Vector data generally approximates or simplifies the physical land surface. For instance, maps might represent streets, rivers and railroad tracks as simplified lines, which are not always 100 percent accurate, but are usually sufficiently accurate to the scale at which they are used. An image shows exactly how these features are positioned.

## Sources

Geographic information comes from a variety of sources. Existing data sets might already exist within your organization or can be obtained from government or commercial sources as either raster or vector digital files. Certain applications might require higher resolution or more recent data. In these situations, you might need to contact commercial distributors of satellite and aerial images.

Aerial imagery is typically obtained from quality remote-sensing systems—such as the Leica ADS40 Airborne Digital Sensor, the Leica ALS50 Airborne Laser Sensor and the Leica RC30 Aerial Camera—that are mounted on helicopters or light aircraft that fly a specific route over the terrain under study. Several commercial satellites, such as QuickBird, Landsat, SPOT and IKONOS, offer color and panchromatic imagery taken from low earth orbit. Resolutions and formats vary.

## Formats

Depending on the use of the information and the area of interest, geographic imagery can exist in a variety of formats, from JPEG to GeoTIF and MrSID to IMAGINE formats. Vector data formats vary according to the GIS systems used to generate the information. These formats include ESRI ArcInfo coverages, ESRI Geodatabase and Microstation formats. It is critical for GIS professionals to be able to access all types of formats; otherwise, the best quality output cannot be produced.

## *Determining the Right Imagery*

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With all the geospatial imaging formats available, choosing the correct imagery for a particular project can be a daunting task. The answers to the following questions will help indicate the type of imaging appropriate for your purposes:

**What type of imagery is needed?** Color or panchromatic? Radar or photographs? Satellite or aerial? Determining the type of imagery needed is the first step in producing the desired output. For example, if the study involves vegetation, then it may be important to include the red and near infrared wavelengths.

**How recent must the data be?** Will archived datasets from 1987 be sufficient, or is something more recent required? If the project involves a study of changes over time, archived and recent data are both important.

**How high a spatial resolution do I need?** Is very high resolution required, or will lower resolution suffice? High-precision images are not always required to perform useful analysis.

**How accurate does the imagery need to be?** As with spatial resolution, the desired output might require very precise imagery. Some projects could be disastrous if pinpoint-accurate imagery is not used.

**Is the information already available?** Archived data might already exist in raster or vector formats. If you are mapping changes to an area, it is important to use existing data as well as new data.

## *Determining the Right System: Beyond GIS*

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With changes in the economy and consolidation of job functions, the roles of GIS professionals have often expanded beyond traditional GIS functions. With this shift in mind, tools traditionally used by GIS professionals are many often no longer adequate.

GIS packages are Geographic Information Systems, not Geographic Imaging Systems and therefore—understandably—often fall short when applied to raster imagery. Although GIS professionals use GIS packages to manipulate imagery, with the help of third-party applications, a GIS simply is not designed for those

tasks. For today's professional, efficient and accurate data preparation is key. Simply reading imagery is not sufficient; extracting useful information, relating it accurately and getting it into the GIS is the ultimate goal.

### **Data Compatibility**

Another complication especially relevant today is data compatibility. There are hundreds of formats available, the majority of which most GIS packages cannot read. A successful project might depend on imagery in a format that your GIS cannot handle. For example, a forestry company might want to project potential revenues based on the number of trees on its land. Comparing recent satellite images against a known vector database, such as an ESRI Geodatabase, requires a system that can read and analyze the various image-data and vector-data formats together.

### **Efficiency**

Many GIS packages do not display images quickly or efficiently, and third-party packages do not always integrate well with GIS software. For example, to compare data side by side, you might be forced to juggle multiple copies of an application on your desktop. However, when one image is roamed, the others do not automatically follow. The ability to compare multiple images and multiple formats simultaneously is critical to handling large-scale GIS projects efficiently.

### **Viewing, Reprojecting and Compressing**

Viewing multiple, large-format images simultaneously can be problematic. Reprojection can be slow and user-intensive, and professionals who depend on third-party packages to compress data often find they have lost much of the information that makes the data geospatial, such as projection parameters. For example, when comparing images with different projections, such as Universal Transverse Mercator (UTM) vs latitude/longitude, the ability to display and compare quickly and easily is vital.

### **The Ideal Solution**

The result of using the wrong software is clear: lost productivity, which equates to lost money. The ideal solution should read the many different image formats and display them all on-screen. It should provide the ability to link geographically related objects between the various vector and raster images for easy updating and feature extraction, and it should provide professional map generation tools and allow you to save extracted features to your GIS format or ESRI Geodatabase.

### ***The Leica Geosystems Solution: IMAGINE Essentials®***

IMAGINE Essentials, part of the ERDAS IMAGINE® suite from Leica Geosystems GIS & Mapping, provides all of the fundamental tools for GIS professionals to produce quality projects.

IMAGINE Essentials provides you with an intuitive and customizable interface to manage geographical information. It imports and exports more than 100 of the most commonly used raster and vector formats, and it reprojects this data to various formats without compromising accuracy. IMAGINE Essentials can stand alone or work alongside other GIS software packages, such as ESRI ArcGIS or MapInfo.

IMAGINE Essentials also provides the IMAGINE Geospatial LightTable™ (GLT) to simultaneously view vector and raster maps and images, allowing you to reference key elements among the different views. For example, the IMAGINE GLT™ allows you to view a scanned map alongside a satellite image and an aerial photograph, link key

geographical points and update the vector features. The IMAGINE GLT makes navigation easier by using one tool to manage multiple images and provides access to IMAGINE Essential's powerful embedded tools, such as reprojection and data compression.

IMAGINE Essentials was designed to process geographic image data quickly without compromising the integrity of the data. You can update your vector feature database by importing your imagery, geometrically correcting it, overlaying the vectors and updating the features. Powerful batch-processing tools automate time-consuming tasks, such as importing and reprojecting hundreds of images from State Plane to UTM, in a reasonable time. IMAGINE Essential's JPEG2000 compression can reduce 10GB of data to 500MB, small enough to distribute on a CD.

As an imaging system, IMAGINE Essentials offers raster- and vector-image manipulation and management, 2D-modeling tools with surface feature simulation, spectral image classification and map generation tools.

### **Image Manipulation**

Read, create, edit and write ArcInfo, Shapefile, Simple Personal Geodatabase and SDE-vector information using built-in, ESRI vector data models. Add points, lines and polygons to existing data, or edit attribute data to vector information. Reprojections between image formats are handled quickly without loss of accuracy.

### **Image Management**

IMAGINE Essential allows you to index, view, archive and retrieve imagery from anywhere on a network, find imagery by geographical location and customize a catalog for each project or for your entire organization.

### **Static 3D Modeling**

Use surface elevation information, such as a digital elevation model or DEM, to create a 3D view of geographic surfaces from custom-defined observer positions. Create customized background sky and atmosphere effects and drape the 3D model with various imagery types to create photo-realistic views of the ground.

### **Cartographic Map Production**

Using IMAGINE Essential's cartographic-quality map composition tools, you can create, scale and print custom maps, build customized map templates or automatically generate USGS and international map series at any scale.

## ***The Australian Geological Survey Organization Updates National Mapping Database Vector Data***

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### **Challenge**

Many organizations are responsible for creating, updating and maintaining digital vector databases. They need to be able to vectorize data from existing paper maps, but they also need to constantly revise the data with up-to-date information or provide new information by interpreting secondary data sources.

### **Solution**

The Australian Geological Survey Organization (AGSO) in Canberra, Australia, is responsible for creating and updating a variety of geologic and other thematic maps for the entire continent of Australia. AGSO chose ERDAS IMAGINE to complement its GIS because IMAGINE provides the quickest, easiest way to create ESRI ArcInfo vectors from raster data or to update ArcInfo vectors from an existing GIS database.

AGSO used IMAGINE Essentials to integrate, update and manipulate ESRI's ArcInfo coverages within the IMAGINE environment, meaning the vectors and their attributes remained in the ArcInfo format as they were viewed and edited over new imagery. There was no file conversion needed, so no translation errors could occur. Manipulated coverages were directly analyzed in the ArcInfo GIS.

Existing paper maps of geological structures served as a good initial source of digital vectors via the use of digitizing tablets, but these maps were decades out of date, at scales too small to be useful or were difficult to obtain for more remote regions. Thus, more up-to-date sources were required for interpreting features.

Satellite imagery and other data provided an extremely cost-effective source of information, allowing more frequent update of data than from field surveys. For example, ASGO processes and uses many disparate sources of data—including satellite images, aerial photographs, radar, radio-metric, magnetic and gravity—to aid in the interpretation and mapping of subsurface geology. These raster data types are accessed in IMAGINE Essentials, corrected to a common projection system and merged to provide multi-layer, multi-temporal, large-scale imagery for interpretation.

Existing geologic vector coverages are overlaid directly on these images, either individually or simultaneously, to allow geologists to compare data sets visually on screen and edit as needed using IMAGINE Essentials.

**Results:**

AGSO was able to rapidly produce spatially accurate, up-to-date thematic databases and maps for Australia.

***Ease of Use***

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Busy professionals are already pressed for time without the added pressure of learning a new system. IMAGINE Essentials is built with the GIS professional in mind. Common, generic tools and a graphical interface make learning fast and easy. If you prefer a customized environment, IMAGINE Essentials comes with a preference editor. All operations within ERDAS IMAGINE are supported by extensive hypertext on-line help, as well as context-sensitive help options.

***Ease of Customization***

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IMAGINE Essentials has an intuitive graphical user interface that is easily modified to suit your particular production environment. IMAGINE Essentials is delivered with the ERDAS Macro Language, or EML, a scripting language that allows modification of the interface or adding/accessing extra functions to produce custom applications.

***A Name You Can Trust***

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For over 80 years, geospatial professionals have looked to Leica Geosystems for proven photogrammetric solutions across the entire Geospatial Imaging Chain. Leica Geosystems, one of the most respected names in the industry, is a geomatics technology company providing the largest range of solutions for capturing, referencing, measuring, analyzing and presenting geospatial data.



## **Key Features and Capabilities**

The solutions discussed in this paper represent only a few of the solutions offered in IMAGINE Essentials. A comprehensive geospatial imaging system, IMAGINE Essentials allows you to reference, measure, analyze and present GIS information using a single, comprehensive software package.

### **Data Visualization**

- Geospatially linked viewers
- Look-up table manipulation
- Data and attribute editing
- Spatial and spectral measurement
- 3D view generation

### **Data Integration**

- Direct read of open formats
- Import/export routines
- Access to attribute information

### **Classification**

- Unsupervised classification

### **Batch Processing**

- Batch Wizard records and schedules processes
- Apply to multiple file lists
- Schedule jobs for overnight processing

### **Coordinate Calculator**

- On-the-fly warping and reprojection

### **Vector Editing**

- Built-in ESRI data models
- Vector editing tools
- Automated viewer roam

### **Geometric Correction**

- Extendible geometric models
- GCP editor
- Standard and user-defined projection libraries

### **Image Management**

- Graphical Image Catalog
- Data archiving and retrieval

### **Cartographic Map Production**

- Custom map definition tools
- Drag-and-drop map objects
- Map templates
- Map series generation
- Industry standard printer language support

## System Specifications

ERDAS IMAGINE is supported under the following platforms.

### Requirements for Microsoft Windows Platforms

#### Minimum System Requirements

<b>Computer/Processor</b>	Intel Pentium II or any 100 percent compatible computer (Pentium 4 recommended)
<b>Memory</b>	256 MB (1 GB highly recommended)
<b>Operating System</b>	Any of the following: <ul style="list-style-type: none"><li>• Microsoft Windows XP Professional (512 MB memory required)</li><li>• Microsoft Windows 2000 Professional with Service Pack 2 (or higher)</li><li>• Microsoft Windows 2000 Server with Service Pack 2 (or higher)</li></ul>
<b>Media Reader</b>	Microsoft Windows compatible CD-ROM drive
<b>Display</b>	<ul style="list-style-type: none"><li>• Super VGA compatible 1024 X 768 X 24 bit colors</li><li>• DirectX 8 (or higher) hardware acceleration recommended</li></ul>
<b>Software</b>	<ul style="list-style-type: none"><li>• OpenGL 1.1 or higher (for IMAGINE VirtualGIS® and Image Drape utility)*</li><li>• Microsoft Visual C++ 6.0 SP 5A (required for IMAGINE Developers' Toolkit™)</li><li>• Internet Explorer 5 or Internet Explorer 6 using Java 1.3 runtime (for online help and IMAGINE Geodatabase Support option)</li><li>• Adobe Acrobat Reader 5.0 or compatible (for online documentation)</li></ul>
<b>Peripherals</b>	<ul style="list-style-type: none"><li>• One Microsoft Windows compatible mouse (Intellimouse recommended)</li><li>• One Centronics parallel port (if using the optional hardware key for security, must have Ethernet card with TCP/IP configured if not using hardware key)</li></ul>

#### Digitizing Tablets\*\*

<b>Altek</b>	<ul style="list-style-type: none"><li>• 16-button cursor</li><li>• AC30, AC31 or AC41 controller</li><li>• One RS-232 serial port</li></ul>
<b>CalComp Drawing Boards II &amp; III</b>	<ul style="list-style-type: none"><li>• 16-button cursor</li><li>• One RS-232 serial port</li></ul>
<b>CalComp 9100 and 9500 Series</b>	<ul style="list-style-type: none"><li>• 16-button cursor</li><li>• One RS232 serial port</li></ul>
<b>GTCO DIGI-PAD Series</b>	<ul style="list-style-type: none"><li>• 16-button cursor</li><li>• Version Z1.9X or S1.9X firmware</li><li>• One RS232 serial port</li></ul>

#### Display Devices

The ERDAS IMAGINE drape utility, IMAGINE VirtualGIS and Stereo Analyst® require OpenGL. Microsoft Windows XP and 2000 provide a generic OpenGL driver for supported graphics cards. However, an OpenGL optimized graphics card and driver are recommended for these applications.

#### Hardcopy Devices

Microsoft Windows supported hardcopy devices.\*\*

#### Tape Drives

- Local: Any Microsoft Windows supported tape drive
- Remote: Any tape drive connected to a UNIX machine running the ERDAS IMAGINE tape server utility may be accessed across a local area network (LAN)

## Requirements for UNIX Platforms

### Minimum System Requirements

<b>Computer/Processor</b>	Sun SPARC workstation
<b>Memory</b>	128 MB memory; 512 MB highly recommended
<b>Swap Space</b>	200 MB
<b>Operating System</b>	Sun Solaris 8 or 9
<b>Media Reader</b>	CD ROM drive
<b>Software</b>	<ul style="list-style-type: none"> <li>• OpenGL 1.2.1 or higher for IMAGINE VirtualGIS and Image Drape utility</li> <li>• Sun Forte Developer 6 Update 2, C and C++ or SunONE Studio 7 Compiler Collection, required for IMAGINE Developers' Toolkit</li> <li>• Netscape Navigator 4.7x bundled with Solaris, required for online help</li> <li>• Adobe Acrobat Reader 5.0 for online documentation, must be configured to work with Netscape</li> </ul>

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### Display Devices

<b>8-bit</b>	<ul style="list-style-type: none"> <li>• Sun Standard CG3</li> <li>• Sun Standard Turbo GX and Turbo GX+</li> <li>• Sun SX</li> </ul>
<b>24-bit</b>	<ul style="list-style-type: none"> <li>• Sun Standard GS with three Sbus slots</li> <li>• Sun CREATOR 3D*</li> <li>• Sun ELITE 3D*</li> <li>• Sun Expert 3D*</li> </ul>

### Hardcopy Devices

ERDAS IMAGINE supports PostScript Level II and HP-RTL output.\*\* Any device that supports these languages should work with ERDAS IMAGINE.

\* Microsoft Windows provides a generic OpenGL driver for all supported graphics cards, however, an OpenGL optimized graphics card and driver are recommended for these applications.

\*\* New models are added to the specification when they have satisfactorily completed testing.

\* Required to run IMAGINE VirtualGIS.

\*\* HP-RTL drivers are recommended.



## **The ERDAS IMAGINE Product Suite**

ERDAS IMAGINE products are structured in a tiered fashion, with IMAGINE Essentials as the base tier. Each tier of ERDAS IMAGINE includes and extends the functionality of the previous level. Together with the ability to "float" these individual components across a network, the tiered approach enables you to purchase an integrated system that meets your processing requirements and is flexible enough to accommodate changes in your workflow.

**IMAGINE Essentials®:** A powerful, low-cost image mapping and visualization tool that allows different types of geographic data to be combined with imagery and quickly organized for projects. IMAGINE Essentials provides a robust set of tools for geocorrection, image analysis, visualization and map output.

**IMAGINE Advantage®:** A geographic imaging toolset that extends the capabilities of IMAGINE Essentials by adding more precise mapping and image processing functions. IMAGINE Advantage includes a complete set of tools to analyze data from imagery via mosaicking, surface interpolation, advanced image interpretation and orthorectification.

**IMAGINE Professional®:** The most sophisticated software for geographic imaging, IMAGINE Professional includes complex image analysis, radar analysis and advanced classification tools. It also includes graphical spatial data modeling, which is a unique capability for analyzing geographic data.



**POWERING GEOSPATIAL IMAGING™**

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